AMENDMENTS TO THE DRAWINGS

The replacement drawing sheets are amended to add the designation "Prior Art" to Figs. 1A, 1B, 2, and 3A-3D.

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REMARKS

Claims 1-27 are pending in the application, of which Claims 1, 10, and 18 are independent. In the Office Action, the Examiner notes that Figs. 1A, 1B, 2, and 3A-3D should be designated by a legend such as --Prior Art--. Also, the Examiner objects to the specification for various informalities.

Each of Claims 1-27 is rejected and/or objected to in the Office Action for the following reasons: Claims 1 and 20 are objected to for lack of clarity and precision; Claim 2 is rejected under 35 U.S.C. § 112 for reciting a claim limitation with insufficient antecedent basis; Claims 1-3, 5-6, 8-20, and 25-27 are rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,628,330, issued to Lin (hereinafter "Lin"); Claim 4 is rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of U.S. Patent Application Publication No. 2003/0118231, filed by Uchida et al. (hereinafter "Uchida"); and Claims 7 and 21-24 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Lin in view of U.S. Patent No. 5,113,252, issued to Horie et al. (hereinafter "Horie").

In view of the amendments and remarks discussed in detail below, applicants respectfully submit that Claims 1-27 are in condition for allowance.

Drawings Amendments

Figs. 1A, 1B, 2, and 3A-3D are presently amended to include the designation "Prior Art" in accordance with the Examiner's instructions. Replacement drawing sheets are attached.

Specification Amendments

The Specification is amended to correct the informalities objected to in the Office Action. In addition, several amendments are presently included to correct other informalities due to minor typographical errors. These amendments are believed to be apparent on their face and do not introduce new matter into the application.

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Claims Amendments

Claims 1 and 20 are presently amended to correct the informalities objected to in the Office Action. Claim 21 is also amended to correct minor typographical errors. Further, Claim 2 is amended to overcome the rejection under 35 U.S.C. § 112 by providing proper antecedent basis for the limitation "the selection signal." In addition, Claims 1, 10, 18, and 22 are amended to more clearly distinguish the claimed subject matter from the references cited by the Examiner.

Rejections under 35 U.S.C. § 102(e)

In the Office Action, the Examiner rejects Claims 1-3, 5-6, 8-20, and 25-27 under 35 U.S.C. § 102(e) as being anticipated by Lin. Briefly, Lin teaches a digital signal processor that integrates color interpolation with edge detection. Referring to Fig. 4, an alternating-line color interpolator and edge detector has an input for receiving a stream of mono-color pixels from an image sensor. Pixels are input to the interpolator and edge detector in 3x3 patterns having red (R), blue (B), and green (G) pixels arranged in a Bayer pattern.

A red interpolator receives red pixels and averages the red pixels within the 3x3 region to generate an interpolated red pixel for a center location of the 3x3 region. A blue interpolator receives blue pixels in the 3x3 region and averages the blue pixels within the 3x3 region to generate an interpolated blue pixel for a center location of the 3x3 region. A green interpolator receives green pixels in the 3x3 region and averages selected green pixels within the 3x3 region to generate an interpolated green pixel for a center location of the 3x3 region.

Referring to Fig. 6, an edge detector receives green pixels in the 3x3 region and multiplies each green pixel by a filter coefficient and sums the results to generate an edge value, EDGE. Figs. 9A and 9B show the filter coefficients for odd lines and even lines, respectively. When the 3x3 image has a green pixel in the center position, the value EDGE produced by the

edge detector is equal to the difference between the value of the green pixel at the center position and the average value of the green pixels at the four corner positions. When a red or blue pixel is at the center position of the 3x3 region, the value EDGE is the difference between the sum of values of the green pixels in the center column and the sum of the values of the green pixels in the middle row. Thus, the edge detector detects a value EDGE for each pixel in the stream of mono-color pixels received from the image sensor, regardless of the color of the pixel.

Referring to Fig. 10, an edge enhancer 52 receives the interpolated full-color R, G, B pixels from the interpolator for each pixel. An absolute unit 75 generates the absolute value of EDGE, |EDGE| and outputs the absolute value to a pair of comparators 74, 76. Comparator 74 compares |EDGE| to a green threshold value, G_THRES. When |EDGE| is greater than G_THRES, the comparator 74 signals a mux 70 to select the green scale factor G_SCALE_FACTOR for output to a multiplier 63. The multiplier 63 multiplies the edge value EDGE by the green scale factor, and the result is added to the interpolated green value. Accordingly, the green value is enhanced when an edge is detected. When the edge value does not exceed G_THRES, the mux 70 selects a 0 value for output to the multiplier 63. As a result, multiplier 63 outputs 0 to the summer 61, and the green value passes through the summer 61 without being enhanced.

Claim 1

As currently amended, Claim 1 of the present application recites an apparatus for performing edge enhancement. The apparatus includes an interpolation unit performing an interpolation operation. The apparatus further includes "an edge detection unit performing an edge detection operation... in parallel to the interpolation operation of the interpolation unit and *selectively outputting an edge detection value according to a selection signal representing a pattern of the image data stored in the register*" (emphasis added). Thus, the edge detector

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recited in Claim 1 performs an edge detection operation and then does or does not output the generated edge detection value depending on a selection signal that corresponds to the pattern present in the register. One disclosed embodiment illustrates this limitation as follows: "When the pixel value of the center pixel of the 3x3 window is not the G value, the edge detection value X is not transmitted to the first adder 408" (Specification at page 16, lines 22-24).

In contrast to the edge detector recited in Claim 1, the edged detector disclosed in Lin outputs an edge detection value for every pixel in the stream of mono-color pixels received from the image sensor. Instead of controlling whether or not an edge detection value is output based on the pattern of the 3x3 window (i.e., the color of the center pixel), Lin teaches applying different filter coefficients, depending on the color of the center pixel in the 3x3 window. While the applied filter coefficients vary, an edge detection value is nonetheless calculated and output for each pixel when it is at the center of the 3x3 window, regardless of the color of that pixel. Thus, Lin teaches *selectively calculating* an edge detection value, but does not teach or suggest *selectively outputting* a calculated edge detection value from the edge detection unit according to a selection signal representing a pattern of the image data.

For at least the foregoing reasons, applicants respectfully submit that Lin fails to teach or suggest each and every limitation of Claim 1. Accordingly, applicants respectfully request the withdrawal of the rejection of Claim 1. If Claim 1 is allowed, then Claims 2-3, 5-6, and 8-9, which depend therefrom, should also be allowed.

Claim 10

As presently amended, Claim 10 recites a method of performing edge enhancement, the method comprising sensing an image and storing the image data in a register. The method further includes "performing an interpolation operation on the image data received from the register" and "performing an edge detection operation on the image data received from the

register in parallel to the interpolation operation and *selectively outputting* an edge detection value *according to a selection signal representing a pattern of the image data*" (emphasis added). As discussed with regard to Claim 1, Lin does not teach or suggest that the detection signal is "selectively output" according to a selection signal that represents a pattern of the image data.

For at least this foregoing reasons, Lin does not teach or suggest each and every limitation of Claim 10. Accordingly, applicants respectfully submit that Claim 10 is in condition for allowance. If Claim 10 is allowed, then Claims 11-17, which depend therefrom, should also be allowed.

Claim 18

Claim 18 recites an apparatus for performing edge enhancement that includes an interpolation unit performing an interpolation operation on image data received from a memory unit. The apparatus further includes "an edge detection unit performing an edge detection operation on the image data received from the memory unit to detect an edge detection signal and *selectively outputting the edge detection signal according to a pattern of the image data* stored in the memory unit when the interpolation unit performs the interpolation" (emphasis added). As discussed with regard to Claim 1, Lin teaches an edge detection unit that outputs an edge detection value for every pixel in a the image data. Unlike Claim 18, Lin does not teach or suggest "selectively outputting" the edge detection signal "according to a pattern of the image data."

For at least the foregoing reasons, applicants respectfully submit that Lin does not teach or suggest each and every feature of Claim 18. Accordingly, applicants respectfully request that Claim 18 be allowed. If Claim 18 is allowed, then Claims 19-20 and 25-27, which depend therefrom, should also be allowed.

Rejections under 35 U.S.C. § 103(a)

Claim 4

Claim 4, which depends from independent Claim 1, stands rejected under 35 U.S.C. § 103(a) as unpatentable over Lin in view of Uchida. In the Office Action, the Examiner relies on Lin to teach all of the features and limitations of Claim 4 except for a control unit "outputting the reference value to the comparison unit." The Examiner relies upon Uchida to supply this limitation. As previously discussed, Lin does not teach or suggest selectively outputting the edge detection value according to a selection signal representing a pattern of the image data as recited in Claim 4. Uchina discloses an image processing method and apparatus, but does not teach or suggest selectively outputting the edge in the manner recited in Claim 4.

For at least the foregoing reasons, applicants respectfully submit that a theoretical combination of Lin and Uchina would not teach or suggest each and every limitation of Claim 4. Accordingly, applicants respectfully request that the rejection of Claim 4 be withdrawn.

Claim 7

Claim 7, which depends from independent Claim 1, stands rejected under 35 U.S.C. § 103(a) as unpatentable over Lin in view of Horie. In the Office Action, the Examiner relies on Lin to teach all of the limitations of Claim 1. The Examiner relies on Horie to teach the use of the equation $X=4Gc-(G_1+G_2+G_3+G_4)$, where X is the detection value, 4Gc is the center pixel value, and G_1-G_4 are the adjacent pixel values. As previously discussed, Lin does not teach or suggest selectively outputting the edge detection value according to a selection signal representing a pattern of the image data as recited in Claim 7. Horie is directed to an image processing apparatus including a means for performing thinning and fattening processing, but does not teach or suggest selectively outputting the edge in the manner recited in Claim 7.

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Inasmuch as neither Lin nor Horie teaches or suggests selectively outputting the edge detection in the manner recited in Claim 7, even a theoretical combination of Lin and Horie would not teach or suggest each and every limitation of Claim 7. Accordingly, applicants respectfully request that Claim 7 be allowed.

Claims 21-24

Claims 21-24, which depend from independent Claim 18, stand rejected under 35 U.S.C. § 103(a) as unpatentable over Lin in view of Horie. In the Office Action, the Examiner relies on Lin to teach all of the limitations of Claim 18. The Examiner relies on Horie to teach various limitations recited in Claim 21-24 that are not taught or suggested by Lin. However, as previously discussed with regard to Claim 7, neither Lin nor Horie teaches or suggests selectively outputting the edge detection as recited by Claims 21-24.

For at least the foregoing reasons, Lin and Horie, even when theoretically combined, would not teach each and every limitation of Claims 21-24. Accordingly, applicants respectfully request that the rejection of Claims 21-24 be withdrawn.

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CONCLUSION

In view of the foregoing amendments and remarks, applicants respectfully submit that Claims 1-27 are in condition for allowance. An early and favorable action allowing these claims is respectfully solicited. The Examiner is requested to contact the undersigned should the Examiner have any questions.

Respectfully submitted,

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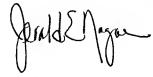

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